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Safekids New Zealand
Position Paper:

CHILD DRIVEWAY RUN OVER INJURIES

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Safekids New Zealand Position Paper:

CHILD DRIVEWAY RUN OVER INJURIES

Summary

It is estimated that every two weeks a child is hospitalised with serious injuries received from a vehicle driving on a private driveway in New Zealand (1998-2001 and 2001-2005). During this time, each year, a further five children are killed in the same way.

A typical child injured in a driveway incident is a toddler, aged about two years old, of Māori or Pacific ethnicity, living in an area of high socio-economic deprivation, and residing in high household occupancy dwellings. Children are often severely injured as a result of driveway run over injuries, and while not always fatal, the injuries are often associated with long lasting disability and impairment. The driver is usually a close family member. The devastating impact of these events upon families cannot be overstated.

Although research evidence illustrates promising interventions, the application of this evidence has been sporadic, and there is little evaluation evidence demonstrating the impact of proposed interventions.

Evidence presented in this paper suggests that it is possible to reduce the frequency of driveway injury through the application of known strategies. This has been based on the identification of three dominating factors associated with child driveway run overs – human, vehicle and property design factors.

Human Factors:

Overall, there seems to be a general lack of awareness among adults of the risk and impact of driveway run over injuries to children. Parental perception of risk has not been systematically examined. Many drivers and caregivers report they believed they saw the child in a presumed safe position, immediately prior to moving their vehicles. At-risk children are mobile, yet developmentally unable to perceive danger and are too small to be easily visible from the driving position. A lapse in the supervision of a child has proven to be a contributing factor associated with a child driveway run over incident.

Vehicle Design:

Lack of driver visibility from within vehicles, both rearward and forward, is a repeatedly described vehicle feature most implicated in driveway injuries. All vehicles have visibility blind zones. Cars run over more children than any other type of vehicle, but light trucks, commercial vans, four wheeled drive and sport utility vehicles (SUVs) are consistently identified as being over-represented in the numbers of vehicles involved.

Property Design (Built Environment):

Environmental design can influence driveway injury risk levels. High levels of risk are associated with built environmental factors such as driveways exiting onto quiet or less busy road (such as a cul-de-sac or local road), properties with multiple parking spaces and shared driveways with more frequent car movements, and where the driveway length is greater than 12 metres. The only built environmental factor that saw a reduction in the risk of driveway injury was where the pedestrian pathway was separated from the driveway.


DANGER

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1. Introduction

Injuries and deaths from motor vehicles driving at slow speed over children on private driveways persist as a recurring problem. This deeply tragic injury event is internationally recognised as an underestimated injury cause, often having long term and serious consequences for children and their families [1-5].

This injury cause is often referred to as a 'drive over,''roll over,''back over', 'run over', or 'low speed vehicle run over'. Although older children are sometimes involved, children who are injured or die in driveways are usually toddlers aged between one and two years, Māori or Pacific, living in areas of high socio-economic deprivation, and are likely to reside in high household occupancy dwellings. The incident typically occurs when a young child is driven over by a vehicle moving on private land. The vehicle is usually located within a driveway close to a family home [3, 6-10, 12, 17-24, 42].

Incidents happen most frequently when vehicles are moving in reverse (in up to 80% of cases) [22, 42] but also occur when vehicles are moving forward. The driver is often an adult who is related, or known, to the child [3, 6, 8, 9, 12, 14, 18, 22, 44, 47].

It should be acknowledged that drive-over injuries are known to occur in other places such as paddocks and car parks, but these are less frequent.

Another scenario occasionally occurs when an unsupervised child within a vehicle releases the handbrake, causing the vehicle to roll over another child [6, 22, 53].

Higher incidence rates of driveway child death and injury have been observed in Australia (Victoria, Queensland and New South Wales), across the United States and New Zealand (the Auckland region). They are also described as a less frequent, but severe, injury event in the United Kingdom (Leeds) and Austria (University of Graz) [3, 6-13].

New Zealand has one of the highest recorded incidences of child driveway death and injury in the world [53]. On average, five children a year are killed by cars driving on private driveways in New Zealand. Within the Auckland region at least one child every two weeks is hospitalised overnight with injuries from this cause [3, 47]. Of all child pedestrian injuries in the Auckland region, 25 percent occur on private driveways.

Auckland Region: (Child driveway run overs)

- Non fatal injury rate has increased from 7.6 per 100,000 (1998-2001) to 8.4 per 100,000 (2001-2005)
- Mortality rate has remained the same (constant) 0.64 per 100,000 (1998-2001) and 0.63 per 100,000 (2001-2005)

While this may provide some information about severe driveway injuries, the exact size of the problem and the frequency with which it occurs in other parts of the country is untested [3, 11, 14, 44, 47]. Further research is required to investigate this, and to identify if opportunities for effective intervention vary between Auckland as a large urban centre, and other locations around New Zealand.

Yet despite researcher knowledge and awareness of the problem and possible solutions, for over ten years the non-fatal rate has increased and that mortality has remained constant.

This paper outlines the problem, looking at three dominating risk factors: property design, vehicle design and human behaviour. It will also discuss specific actions that can be taken to reduce this injury cause.

2. Injury definition

For the purpose of this paper, a driveway run over injury has been defined as an injury caused by contact with a moving motor vehicle occurring on a driveway. A driveway is defined as any passageway* providing vehicle access between the road and the adjoining property.

(* A passageway is any area accessible by vehicle and includes sealed surfaces (such as concrete, paving or tarmac) and unsealed surfaces (such as grass, gravel or metal)).

3. Trauma description

The burden of injury and disability associated with driveway run over injuries is severe, especially if a crush injury to the head is sustained. When driveway injuries were compared with all other paediatric pedestrian injuries a 10-fold increase in mortality in children less than 5 years of age was described. Death usually occurs at the scene [8, 20-22, 24].

Injuries sustained as a result of driveway run overs include tearing and crush trauma to the child's head and neck, and crush injuries to their chests, abdomens and limbs [2, 8, 13].

Measures of injury severity indicated by length of intensive care unit admission and hospitalisation suggest injuries are worse than for other pedestrian injuries. Younger children injured in driveway run overs often have higher Injury Severity Scores (ISS) than older children [21]. One explanation for this is that younger children have a significantly higher incidence of both head and neck injury due to their size and the position of their heads relative to the external parts of the motor vehicle [8, 21, 22].

Safekids New Zealand developed a driveway run over prevention resource which included safety promotion messages from four high profile public figures. Poster below features TV journalist John Campbell. See page 12 for more information.

4. Undercounting driveway injuries

A number of New Zealand databases include child driveway trauma. However, the way it is defined and counted varies for each database.

Different data sets provide different information about the extent of the problem.

Non-fatal injuries that occur in private driveways are not typically regarded as reportable to the police, and are undercounted in traffic injury statistics, both in New Zealand and overseas (Land Transport Act (1998)).

Studies of driveway injury are derived from hospital admission records. New Zealand published research to date has used admission data from hospitals located within the Auckland region [3, 11, 14, 15, 44]. This data is not exclusively from Auckland, as one hospital in the region accepts admissions from outside of the Auckland region.

New Zealand sources of information relevant to driveway injuries are:

General Practitioners and private accident and emergency services: General practice surgeries and private after-hours emergency rooms see cases of non-fatal child driveway injuries, however these are not available in a consolidated database, and have not been researched.

Hospitals: All admissions to New Zealand hospitals, including deaths, and non-fatal emergency department visits are recorded. Admission records of driveway trauma cases can be accessed for authorised research projects. District Health Boards, who administer hospitals, code data by the International Classification Diseases: version 10 (ICD10) criteria. This coded data is sent to the Ministry of Health's Sector Services unit, who has operational responsibility for national collections of health and disability information.

There is no designated ICD code for driveway related run over injuries. ICD coded data held by the Ministry of Health does not contain driveway injury as a specific category (E Code), but can be searched for via the free text comment box. However, the inclusion of this free text comment box into the data record is arbitrary, hence the unreliability of this data in capturing all child driveway run over injuries. Ministry of Health Sector Services data is not suitable for primary research into this injury cause.

Coronial Information: Mortalities are recorded in the New Zealand Coronial database. Driveway injuries are not classified separately and Coroner's findings are only able to be accessed under specific circumstances, such as for research. While this is possible, New Zealand's small population makes this data suitable only for small number and case analysis.

Police Reports: The New Zealand Police and New Zealand Transport Agency (NZTA) operate the Crash Analysis System (CAS). This is a sophisticated, long term searchable database of police records of crashes on public roads. Driveways are indexed as a crash feature on the CAS database, however the terms of reference for the data base means it only includes injuries that have happened on public roads; events within private property are only very infrequently entered [25].

New Zealand Accident Compensation Corporation (ACC): One of the largest injury databases in New Zealand, this holds information on all persons who have minor and ongoing claims for costs of injuries. ACC data is collected primarily for records of claims. The cause of the injury is entered in a free text box on the initial form (ACC45) that may, or may not, contain key words relevant for searching. This suggests this data will show, overall, an undercount of injuries. See: www.acc.co.nz

5. New Zealand organisations and legislation

A plethora of New Zealand laws, organisations, policies and strategies state that a safe environment must be provided for children. How effectively and consistently this legal framework requires anyone to provide protection to children in specific instances, such as providing improved driveway safety within homes and properties, is not clear [16].

A UNICEF research report published in 2007 placed New Zealand as the worst of all OECD Countries for protecting children from unintentional injury. This provides a compelling indication that improvement can be achieved [26]. In 2009 a similar report comparing OECD countries on policies focused on child well-being – in particular health and safety, showed New Zealand continue to rate poorly against other OECD countries - ranking twenty-ninth out of thirty countries, just ahead of Turkey [48].

5.1 Territorial Authorities

Laws controlling the activities and interests of Territorial Authorities only broadly imply a requirement to provide for child safety from injury accidents.

The purpose of the Local Government Act (2002) does not explicitly require territorial authorities to provide a commitment to improving safety. The Act "… provides for local authorities to play a broad role in promoting the social, economic, environmental and cultural well being of their communities…" (Part 1, section 3, clause (d)).

The purposes of the Resource Management Act 1991 ("RMA") are less equivocal, the Act requires that Territorial Authorities promote sustainable management by *"... managing the use, development and protection of natural and physical resources in a way … which enables people and communities to provide for their social, economic, cultural wellbeing and for their health and safety." (Section 5(2)).*

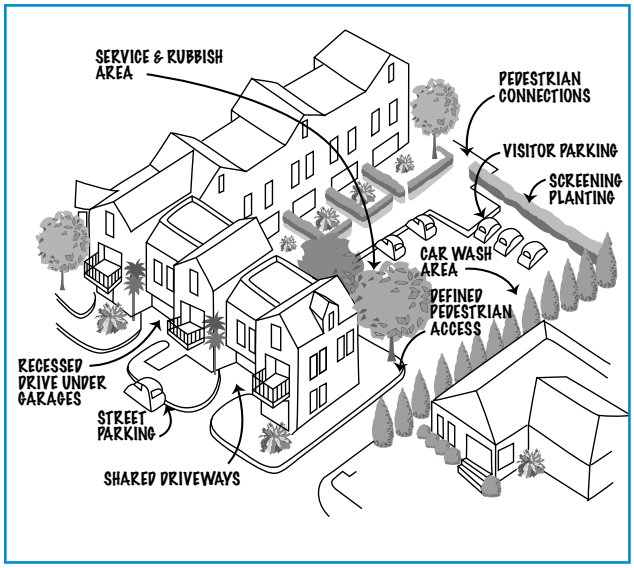
The mechanism to achieve this is through a District Plan. Each Territorial Authority has a District Plan that guides the rules and standards used to control development of land within a district.

Despite the lack of mandate within higher levels of local government legislation, Territorial Authorities have non-statutory policies and strategic documents which can more specifically identify their commitment to improved health outcomes for children.

The New Zealand Urban Design Protocol (2005) has been developed collaboratively by the Ministry for the Environment, Territorial Authorities and other stakeholders as part of a commitment to good urban design. The Protocol identifies seven essential design qualities that together create quality urban design. Amongst them is the custodianship of ensuring design is environmentally sustainable, safe and healthy - a design quality where child injury prevention could be further explored. Signatories make a voluntary commitment to support and implement identified design qualities [27, 54].

Design Codes and Residential Design Guidelines: The former Auckland City Council's (disestablished in November 2010) Residential Design Guidelines document is an example of a non statutory building guideline. This provides guidance on safe design of driveways and car parking – "Access for residents, visitors and vehicles should be carefully designed for safety and minimum intrusion into the neighbourhood." (See figure One). The challenge is to ensure that the new Auckland Council adopts a similar safe design guideline for driveways and car parking [28].

Figure One: Auckland City Council Residential Design Guide for developments in residential zones in strategic growth management areas, showing an ideal separation of driveways from recreation areas (2001). Original image redrawn for clarity by Safekids NZ. Transport.



Land Transport New Zealand District Plan Guidelines for Driveways: In May 1993 the (then) New Zealand Land Safety Standards Branch published safety guidelines for driveways [29]. This guideline was written specifically to be incorporated into District Plans for improved safety of driveways. It provides specific safety measures to reduce injuries happening to pedestrians as vehicles leave and enter driveways: *"For all driveways crossing a footpath there should be a line of clear sight between pedestrians on the footpath and vehicles using the driveway so that collisions are avoided. The area occupied by the driveway should also be well defined so that pedestrians can anticipate vehicle paths across the footpath. … Building Industry Authority DI, Access Routes (5) recommends a 5.0 x 2.0 meter visibility splay for vehicle routes crossing a pedestrian route"* (page 16).

Territorial Authorities have regulatory responsibility for the administration of relevant parts of the Building Act (2004). This Act includes reference to safety in its principles

(a) Principles of the Building Act – [to] "Safeguard people from possible injury, illness or loss of amenity" (page 126).

5.2 Housing New Zealand Corporation (HNZC)

The Housing New Zealand Corporation is the New Zealand government entity responsible for designing, building and maintaining New Zealand Government rental properties under the Housing Corporation Act (1974).

In 2006, HNZC published building design guidelines for high density housing. The section on 'Design Decisions' for vehicle access onto the high density housing site clearly states that designs for vehicles need to consider, "safety for pedestrians, especially children" [30].

A recent report by the New Zealand Injury Prevention Strategy (NZIPS) on New Zealand government expenditure on injury prevention, reported that HNZC had invested $3-4 million annually in injury prevention, particularly in the areas of burns, poisoning, home safety and driveway/road safety. For driveway safety, $500,000 annually was allocated to fencing of family homes (installation of fences in homes with children to prevent them running onto the road or driveway) [49].

Activity	Approximate Annual Cost*
Fitting of smoke detectors in the home	$350,000
Fitting of anti-tip devices to ovens (2008/2009 financial year)	$96,000
Community group housing – Building Warrant of Fitmess (e.g. fitting homes in this category with sprinkler systems	$2,200,000
Fencing of family homes (installation of fences in homes with children to prevent them running onto the road or driveway)	$500,000
Fitting of childproof locks on laundry and kitchen cupboards	$700,000
Publishing of Safety in the Home brochures	$20,000

* Note: Costings are estimates only based on input from subject matter experts.

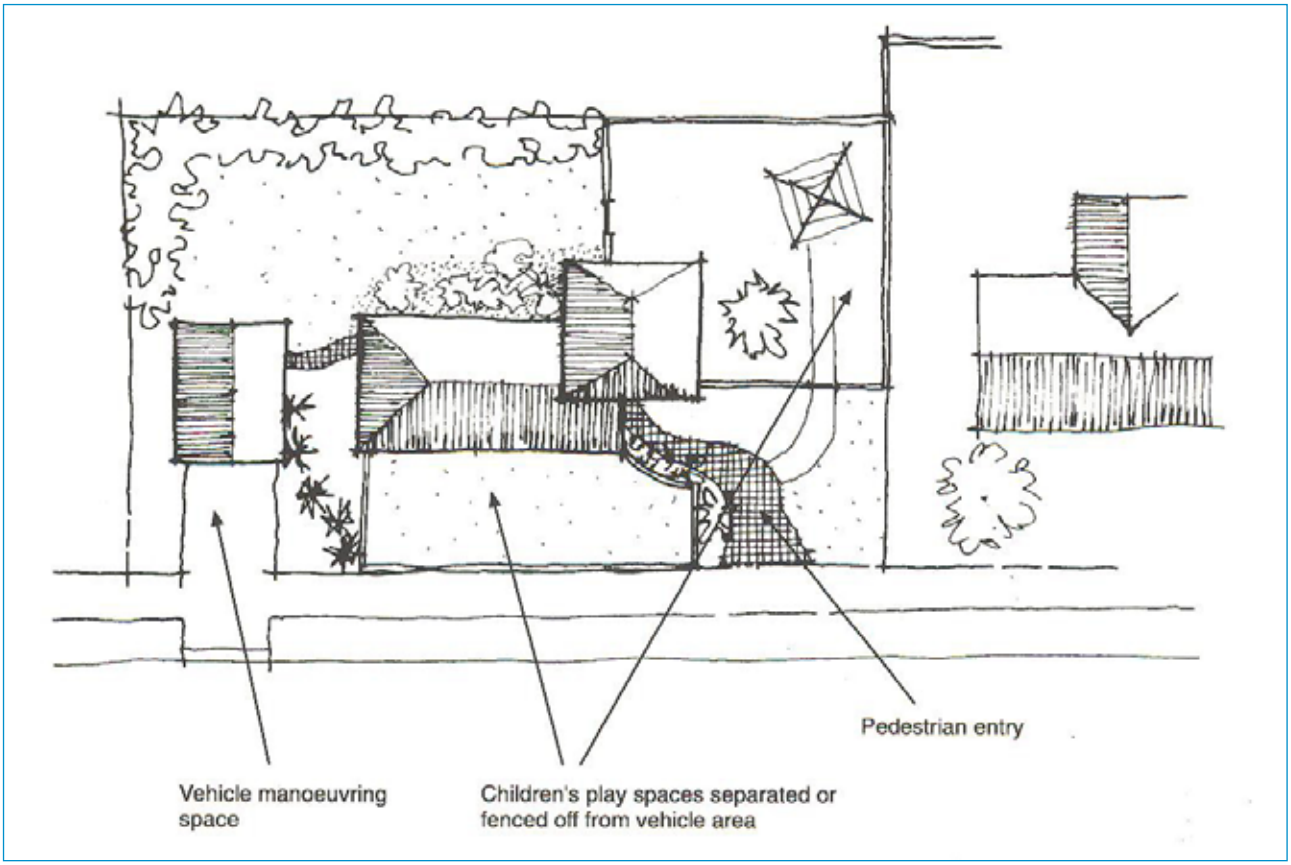
Housing New Zealand Corporation's estimated expenditure on injury prevention, February 2010 [49].

5.3 Standards New Zealand

Accident Compensation Corporation has contracted Standards New Zealand to develop a handbook on safer house design. Safekids New Zealand is represented on the development committee. The handbook will replace the existing Standard, *Safer house design (Guidelines to reduce injury at home) NZS 4102:1996* [55].

The handbook will provide a vital resource for home owners and DIY enthusiasts to enable them to eliminate or reduce the risk of injury by accident in the home by recommending, for example, "Vehicle garaging or parking spaces should be separated and fenced off from children's play spaces".

To help to improve safety, the handbook will be developed as an easy to follow guide with free booklets also developed on specific topics, such as site layout. The publications will suggest best practice design solutions above the minimum requirements of legislation, and will help increase awareness of safer house design for home owners, modifiers and designers to reduce injury in the home.



"Separation of vehicle and pedestrian use of site" from the New Zealand Standard: *Safer house design (Guidelines to reduce injury at home) NZS 4102:1996.* Wellington, Standards New Zealand: 1996. Page 15.

6. Demographic features of driveway injury

A range of demographic variables have been identified as being associated with driveway injuries. These include the age of the injured child, the presence of a close relationship between the driver and child, the size of the family, the ethnicity, household occupancy and the socioeconomic status of the child's family.

There is a strong relationship between driveway injuries and age, with children injured in this way being most frequently between the ages of 0 to 4. Children who are younger also tend to be injured more severely and have a higher death rate [3, 6, 12, 14, 21]. Hsaio et al's study of child driveway run overs in the Auckland region showed that almost three-quarters (73%) of injured children were between the ages of 0 and 4 years.

Studies have shown that higher than average family size, together with the high population density typical of major urban areas are common factors where driveway run overs frequently occur. One Auckland based study looked at household size and found the average number of children living in the household where a child driveway run over injury had occurred was 3.4 children – higher than the average for the total Auckland region, at 2.5 children. [47].

Children from economically disadvantaged backgrounds are consistently identified as experiencing a greater incidence of vehicle related pedestrian injury and mortality.

This appears to hold true for driveway injuries within New Zealand [43, 57], however the mechanism for this is not clearly described.

Studies have also shown that lower value and rental properties are clustered geographically, and may be associated with the geographic distribution of driveway injury events [3, 47].

Hsaio et al's study also considered ethnicity; demonstrating that Pacific Island (43%) children are over represented in the population of driveway injuries than Maori (25%) and European (25%) children [47].

7. Evidence of driveway injury distribution by locality

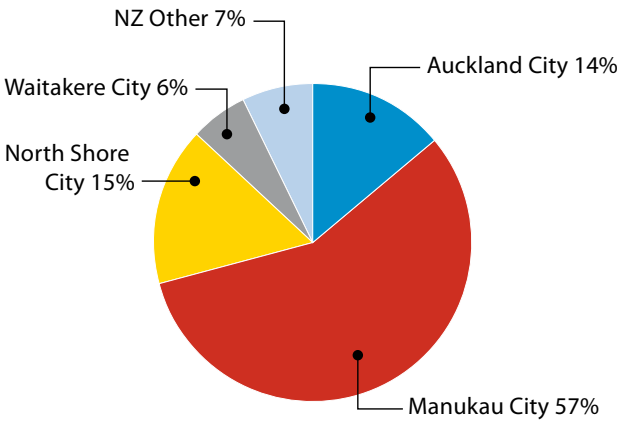
The distribution of driveway trauma and death appears to vary by locality, both internationally and nationally.

The distribution of research studies suggests this is a problem primarily experienced in the USA, Australia and New Zealand. Studies in Leeds (UK) and Graz (Austria) comment on the rarity of the event in these two countries [12, 13].

In New Zealand, Murphy, White and Morreau identified the addresses of 75 hospital admissions for drive-over injuries. Of admissions included in the study, 57 percent were within Manukau City, 14 percent in Auckland City, 16 percent in North Shore City, 6 percent in Waitakere City and 7 percent from elsewhere in New Zealand (see Figure Two) [3].

The exact variables that account for this uneven distribution within these studies are yet to be identified. It is likely that within these localities contributing risk factors (which are drawn upon in section 8) converge to considerably increase the incidence of driveway injury events.

Figure Two: Driveway injury admissions to Starship Hospital by City within the Auckland Region. Murphy, White and Morreau, 2002 [3] Driveway Injuries by City.



Children are sometimes injured when they are on a footpath and a vehicle is moving from, or into, a driveway. This is a much more infrequent event than for injuries on private land but can be studied relatively more simply through the New Zealand Transport Agency' Crash Analysis System (CAS) database.

8. Three factors contributing to driveway injuries

Driveway injury research studies consistently identify three contributing risk factors for driveway injury. These are property design, vehicle design and human factors

Identifying and evaluating the impact of risk factors and how to mitigate their effect is an important part of injury prevention action [31]. Without action on each of the three factors it is unlikely the rate of child injury will be reduced.

8.1 Human factors

The tragic and devastating impact of drive-over events on families cannot be overstated. The injuries are frequently severe, vehicle drivers tend to be closely related to the child, and the tragic event frequently occurs in or near the family home.

'Unavoidable human factors' are often cited as a contributing cause, particularly within police transcripts and coronial reports. Human factors contribute to the risk and require specific and complimentary action with other strategies to reduce this injury cause [38, 39]. Design and environmental improvements to properties will contribute to a reduction in overall risk, however on their own, they will not provide the full solution.

Alongside safety improvements from design measures, programmes to achieve behavioural adaptation are also required. Behaviour change models, while sometimes challenged, have been successfully applied in other areas of injury prevention, such as reducing sports and occupational injuries [38].

Efforts are required to raise awareness and improve the understanding of the problem amongst experts and decision makers who can positively influence the implementation of passive safety measures within the New Zealand design and building community [42, 47].

Research and interventions in relation to the contribution of human factors to child driveway injuries must take into account the range of family behaviour, caregiver supervision, and driver awareness. In addition, research must acknowledge the links with areas of high deprivation, Māori or Pacific peoples, and higher than average household occupancy numbers. When these are combined with the possibility of more effective passive injury prevention measures, these events might be avoided [43, 47].

Parental and caregiver perception of risk about driveway run over injuries has been infrequently examined. When asked about driveway safety, 64 percent of parents said the driveway was a safe place for children to play and was

only made dangerous because of a lapse of supervision [47]. However many drivers and caregivers report they believed they saw the child in a presumed safe position, immediately prior to moving their vehicles [3, 47].

Supervision continues to be a simple but an effective preventive measure against child driveway run over deaths and injuries. Research has proven that the risk of child pedestrian injury in connection with specific supervision practices showed a strong positive association between pedestrian injury and a lack of supervision [52, 56].

Action in relation to human factors

An effective way to change behaviour is through education. Researchers have suggested that the dangers of driveway run overs be included in the New Zealand Roadcode and driver licensing testing by addressing driver awareness and inattentiveness. This can only be enhanced by education programmes which focus on preventative awareness strategies [43, 46, 52].

Internationally, the involvement of high profile and influential champions who increase awareness and urge public action to reduce contributing factors to driveway injury has been highlighted as a useful public awareness activity. At their February 2004 meeting the American College of Surgeons Board of Regents resolved to urge the introduction of legislation to increase the safety of children in and around cars [10].

In 2006, Safekids New Zealand developed a driveway run over prevention resource which included safety promotion messages from four high profile public figures, who were also fathers (see Figure Three). The safety messages focused on key interventions messages of *"Know where the kids are before getting in the car, there's no going back. Check. Supervise. Separate."* Similar programmes have been developed in the United Sates, including a "Spot the Tot" resource developed by Safe Kids Worldwide, based in Washington D.C. [52]

Safekids New Zealand's Driveway Run Over Campaign [50].

Safekids New Zealand, in partnership with other agencies and the media joined forces to support increased wider public awareness about driveway injuries. Media in New Zealand frequently and responsibly cover these events, providing information that outlines the risk and impacts of driveway run over injuries to families and caregivers

Figure Three: Safekids New Zealand's Driveway Run Over Prevention Resource, 2006.

During 2011/12, the Safekids Campaign will focus on Pedestrian Safety, specifically preventing driveway run over injuries. While there are a range of agencies involved in supporting road safety, there is not an identified lead agency to champion driveway safety and to support driveway run over prevention opportunities. Supported by the Key Agency Group stakeholders (comprised of both government and non-government agencies), Safekids will lead the 2011/12 Campaign work in this area.

The Safekids Driveway Run Over Campaign Aims:	1. To increase awareness of the prevention of driveway run overs to tamariki/children, their whānau/family and communities. 2. To target high risk communities. 3. Promote key injury prevention behaviours to reduce the risk of driveway run overs. 4. Promote key injury prevention behaviours to increase driveway safety. 5. To explore opportunities to achieve environmental change.
Key Messages	1. Know where the kids are before getting in the car. 2. Check for children before driving off. 3. Supervise children around vehicles – always. 4. Separate play areas from driveways .
Primary Target Audience	The Safekids Campaign 2011/ 2012 will target workforces and practitioners who engage with infants, tamariki/children, their whānau/ family and communities. The target audience will be inclusive of those working with 0-14 year olds, their whānau/family and communities. • Māori injury prevention providers • Pacific injury prevention providers • ACC Injury Prevention Consultants • Well Child providers • NZ Police including Police Education Officers, Road Policing and community safety teams • Road Safety Co-ordinators • Māori, Pacific and Migrant injury prevention Coalitions • DHBs particularly Public Health staff • Injury Prevention Practitioners.
Secondary Target Audience	• Public, community, whānau/family, parents, tamariki/children from 0-14 years. • Government agencies and decision makers. • Other stakeholders including The New Zealand Automobile Association (AA), Car rental schemes, public sector landlords (e.g., Housing New Zealand, local government etc.).

8.2 Vehicle Design

Cars run over more children than any other type of vehicle, although light trucks, commercial vans, four wheeled drive and sports utility vehicles (SUVs) have also been identified as contributors to this injury cause. Holland described at least a two-fold increased risk of fatality when four wheeled drive or light commercial vehicles were involved [8]. Lack of visibility within these vehicles, both rearward and forward, is a repeatedly described vehicle feature most implicated in driveway injuries [52].

Action in relation to vehicle deign

Following the deaths of 17 children in three and a half years in New South Wales from reversing cars, in 2007, the Australian motoring organization NRMA, studied the blind spots of 270 vehicles. The study was based on the Reversing Visibility Index, available to New Zealanders through the State Insurance website (State Insurance, 2005). The study measured how well a driver could see out of the back of a car. The report also found that less than 1 percent of the vehicles reviewed scored well enough to receive a maximum rating for being able to see a two-year-old behind the vehicle.

Recent activities to improve the safety performance of vehicles around children include the USA National Highways Traffic Safety Authority (NHTSA) initiative to evaluate and promote vehicle technology improvement [40, 41].

In a Report to the USA Congress, the NHTSA detailed testing of several technological systems currently available to mitigate drive over crashes. Testing showed the performance of the sensor based parking aids were typically poor, sporadic and limited in range.

Camera based systems have been described as one tool that could be further explored to reduce injuries, but of limited use. Given the high risk population group for driveway run over's, cameras and other technology are very limited as a public health intervention and are inaccessible and liable to increase inequalities.

Camera performance changes from vehicle to vehicle and rain, fog and other adverse environmental conditions can severely reduce visibility on the screen. Camera reliability is also dependent on the quality or model of camera products – some perform better than others. The cost of high quality and accurate camera based systems range from $700 to $1000 each plus installation costs [51].

Driver response also identifies 'the human factor,' as an important factor in the effectiveness of dashboard camera devices. Driver inattentiveness, speed, affordability and over familiarity were cited as obstacles to the effective use of this technology.

Safekids New Zealand driveway warning sign, developed for the Safekids Campaign 2011/ 2012.

8.3 Property design (Built Environment)

Evidence from research studies indicates that fewer children will be injured in driveways when property and driveway design separates where children might play or walk, from areas where vehicles are driven [3, 6-8,11,12,14,15].

In a New Zealand study of driveway injury, Roberts (et al.) calculated a four fold risk for children in driveways that were not physically separated from the house by a fence [14]. Sapien described a similar three fold increased risk when the play area was not separated from the driveway [34].

Modification of the environment, providing passive protection against adverse events, is a well proven way to protect against injuries. For example, swimming pool fencing and the installation of motor vehicle air bags have substantially reduced the incidence of drowning and death and injury from motor vehicle crashes [32, 33].

In a study of driveway injuries in New South Wales, Australia, Holland (et al.) found that driveways not separated by a fence or building from a child's play area had triple the number of injuries compared to driveways that were separated [8].

Holland studied 42 children (median age 2 years) admitted to hospital with a driveway injury. Typically, Holland observed, the injury happened in the late afternoon or early evening [8]. This may be associated with children using the driveway area for afternoon play, at the same time adults are leaving or entering a property in relation to work and recreation activities [8].

Murphy and Morreau (2002) examined the physical features of properties involved in a driveway run over incident. None of the properties had driveways that were physically separated from the house, and in 56 percent (n=76) of the study cases there was easy access to the driveway from both the front and back of the house [3].

Lighting does not appear to be a feature requiring improvement, with most incidents happening during daylight hours [3, 8].

Hsaio et al examined the environmental features of properties. Of the 45 cases where the driveway and property characteristics were known, 64 percent (n=29) reported that the driveway was the usual play area for the child. This demonstrates the exposure to risk of being run over if they are routinely on the driveway. It also supports the argument for separation of driveway and child play spaces/ areas. The study also found that 51 percent (n=23) of driveways extended into the rear of the section [47].

A case control study by Shepherd et al investigated the built environmental factors (property design) involved in child driveway injuries. The paper also confirmed results from earlier studies that the risk of injury increased due to the design of the built environment (property design). It also suggested that modification of the built environment has the potential to reduce the rate of injuries.

Further examination of these cases found that the only built environment intervention that resulted in a reduction in child driveway run over deaths and injuries was to separate pedestrian access from the property to footpath (path separate to the driveway).

Main findings: Built environment risk of injury.

Built Environment	Risk of Injury	Odds Ratio (95% CI)
Exiting the driveway onto a local (less busy) road	Fivefold risk	OR = 5.5, 95%CI = 2.7–11.2
Additional parking on the property	Threefold risk.	OR = 3.0, 95%CI = 1.6–5.4
Driveway runs along the property boundary	Threefold risk	OR = 2.9, 95%CI = 1.6–5.2
Driveway length greater than 12m	Twofold risk.	OR = 1.8, 95%CI = 1.1–3.0
Driveway exiting onto a cul de sac	Twofold risk.	OR = 2.3, 95%CI = 1.4–3.9

The Shepherd et al study also noted that environmental factors are likely to be part of a more complex picture which includes driver characteristics, child supervision and vehicle characteristics:

- Variations in the driveway design and surroundings are important.
- The type of road the property is on, driveway length, the amount and type of parking present, and the configuration of pedestrian and driveway spaces are associated with changes in the risk.
- This information should be used to modify existing and future residential environments in order to reduce the risk [42].

Action in relation to property design

Evidence reviewed in this paper suggests that Territorial Authorities and Housing New Zealand Corporation (HNZC) are influential stakeholders who are well placed to effectively intervene and reduce the incidence of driveway run over injuries to children. The public policy challenges revolve around exactly what these agencies need to do, and how.

Early recommendations focussed on separating driveways from the house with a fence [14]. HNZC is currently doing this work (see section 5.2).

Other recommendations focus on separating children from places vehicles drive.

This includes reducing direct access from the house into the path of vehicles and providing separate, equivalent and adequate areas for children to play (see Figure Four) [28, 35, 55].

Driver perception of their speed whilst around small children has shown that drivers consistently believe they drive more slowly in the presence of children. This is not demonstrated. Independent monitoring showed actual speeds increased [36].

Slowing vehicle speed is a well demonstrated intervention to reduce child pedestrian injury on public roads [37]. There are no studies, measures or requirements aimed at monitoring or reducing vehicle speed in shared driveways.

Public policy tools for Territorial Authorities can be used to achieve improvement of: the separation between places vehicles drive and small children play, the separation between pedestrian and vehicle access from the house to the footpath, and the inclusion of references to driveway safety within District Plans and within design and building documents.

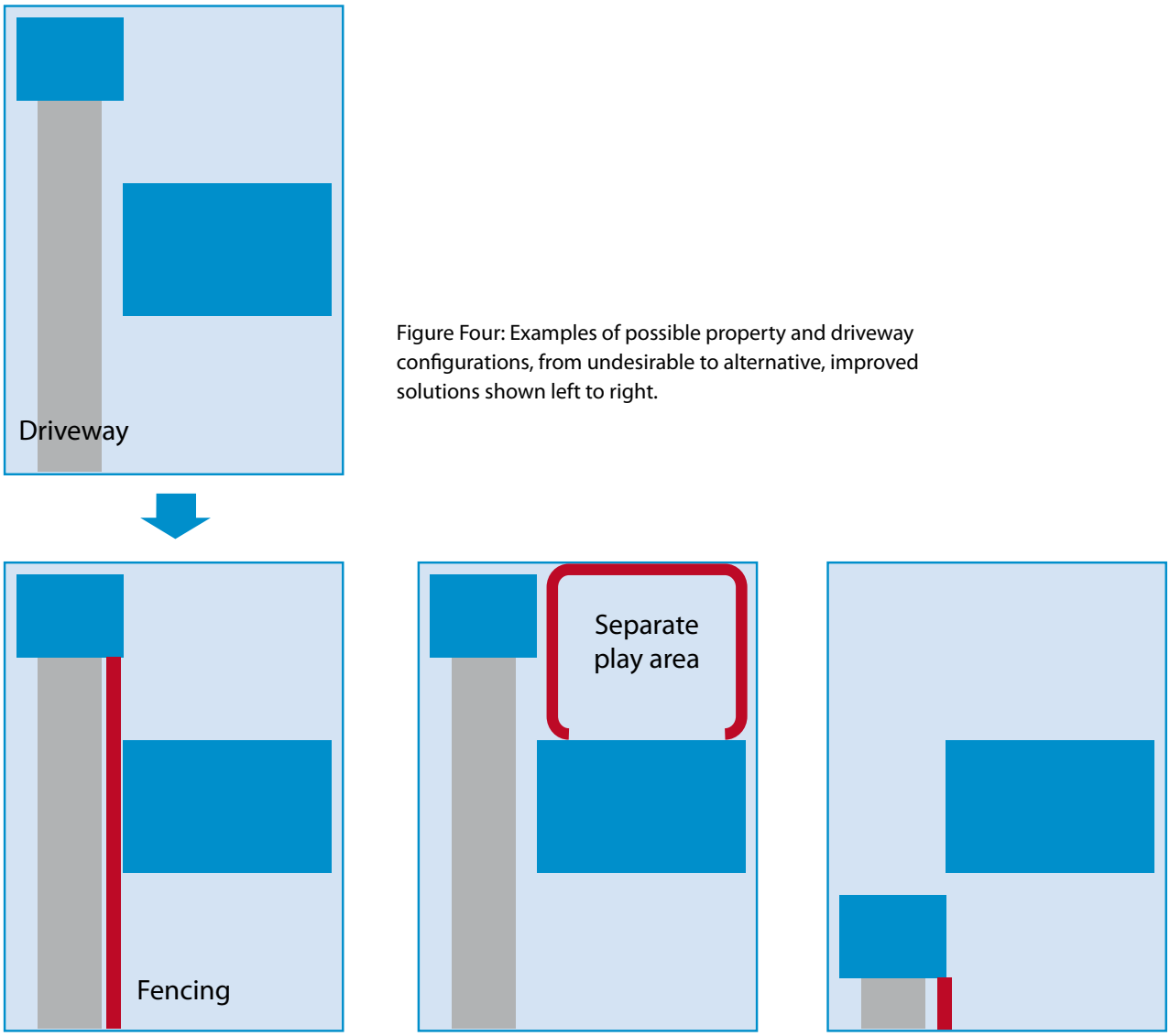


Figure Four: Examples of possible property and driveway configurations, from undesirable to alternative, improved solutions shown left to right.

With changing urban design and higher density living, shared driveways are more common. Shared driveways have two related problems for driveway injuries. The first is when caregivers and families choose to use the driveway as a play area for their small children. The second is anecdotal descriptions of drivers moving at speed within shared space. Injury reports of drive over incidents do not mention speed as a factor, however it cannot be ruled out on the basis of current research [42, 47].

Safe and secure house design guidelines also exist in other countries. "Smart Housing" is an initiative of the Queensland Department of Housing which provides guidelines on safe and secure house design. This guideline recommends that driveways be separated from children's play areas and that doorways do not open directly onto driveways [6].

Safekids driveway run over awareness kits will be distributed to Safekids Coalitions across the country to promote driveway run over prevention messages: Check, Supervise and Separate. Photo, courtesy of the *Nelson Mail*, features Nelson Mayor Aldo Miccio and Tasman Mayor Richard Kempthorne. *Safekids News* March 2011, p. 10

9. Conclusion

The three risk factors for child death and injury on private driveways are:

- Human factors
- Vehicle factors
- Property design (Built Environment)

Without action on each of the three factors it is unlikely the rate of child injury will be reduced. For instance, built environment factors (home and property design) do not exist in isolation. Other societal issues can contribute to additional parking on a non-driveway area within a property – this may include concerns about roadside crime (vehicle theft or vandalism) and higher household occupancy [45]. The same can be said about deprivation or ethnicity. The next step is to develop public policy interventions that will specifically address each of the three risk factors.

Public policy interventions associated with these risk factors are:

- Changes to driveway, property and housing design documents to require greater separation of children from areas where cars are driving on private land
- Education and information to experts, decision makers and the wider public
- Adoption of high quality and affordable vehicle technology to provide greater visibility and driver awareness.

It is also vital that a lead agency be given the mandate to oversee that these policy interventions are implemented and monitored.

There is a need to include better driveway design into built and renovated properties to improve the separation of driveways from play areas in established homes, similar to the work and investment HNZC have been doing to address child driveway safety.

There is a need to amend vehicle design to ensure increased rearward vision, promote greater awareness amongst the general public and improve the awareness of experts in the fields of home and building design.

10. Recommendations

Safekids New Zealand recommends action on each of the following risk factors:

1. That a lead agency be given the mandate to oversee this injury cause.
2. Driveway safety information needs to be included within each territorial authority's residential design guidelines.
    a. Avoid long driveways where possible.
    b. Speed reduction - speed reduction mechanisms and warning signs built into longer driveways.
    c. Separation - greater care in the design, layout and fencing of driveways and/ or children's play areas (depending on site specific layouts) including:
        i. Formalise driveway and parking areas on those properties currently utilising multiple areas for parking - reducing complex vehicle movement patterns.
        ii. Separate pedestrian access to the house from the street should be explored.
        iii. The erection of fences and gates to separate children's play areas from vehicle movement on site should be considered.
        iv. Prioritise site alterations for those properties where the driveways exit onto local roads and cul de sacs to reduce speed.
3. Acknowledgment that every motor vehicle has visibility blind zones.
    a. Inclusion of driveway safety information within driver licensing processes.
    b. Explore the capability of visibility technology such as reversing cameras to reduce child driveway run overs.
4. The provision of research and education programmes to inform the public and provide decision makers with resources to implement improved driveway safety are required.
5. To fully understand the size of the issue and to better inform policy decisions, a designated ICD code for driveway related run over injuries be created and utilised.
    a. The adoption and acceptance of a standard definition which clearly states what constitutes a driveway run over injury.

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